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(71) Applicant

Crabtree Electrical Industries Limited

(Incorporated in United Kingdom)

Lincoln Works, Walsall, West Midlands

(72) Inventor

Ian Jack Pickering

(74) Agent and/or Address for Service

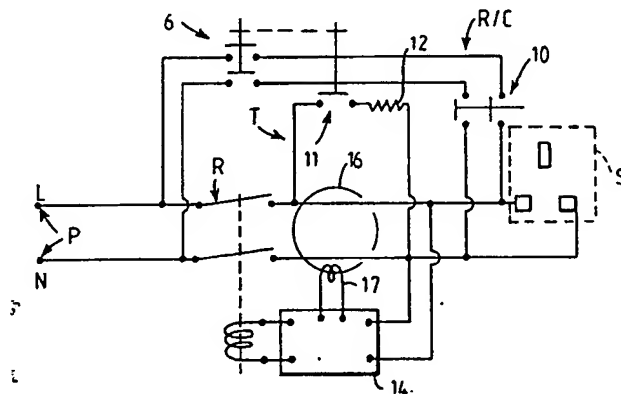
Forrester Kelley & Co
Chamberlain House, Paradise Place,
Birmingham, B3 3HP**(54) Circuit breaker with socket and reset line**

(57) A circuit breaker comprises a power line P extending from terminals N and L to pin apertures of a plug-receiving socket S. Positioned in the power line, across the live and neutral terminals, are contacts of a power relay R which are opened on occurrence of a current overload or detection of a residual current.

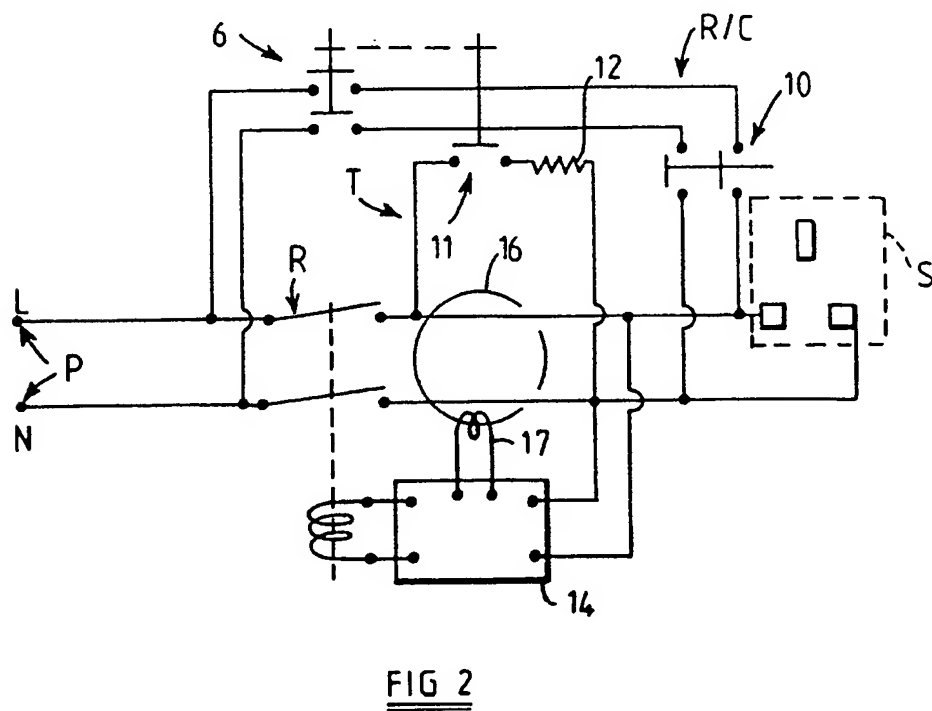
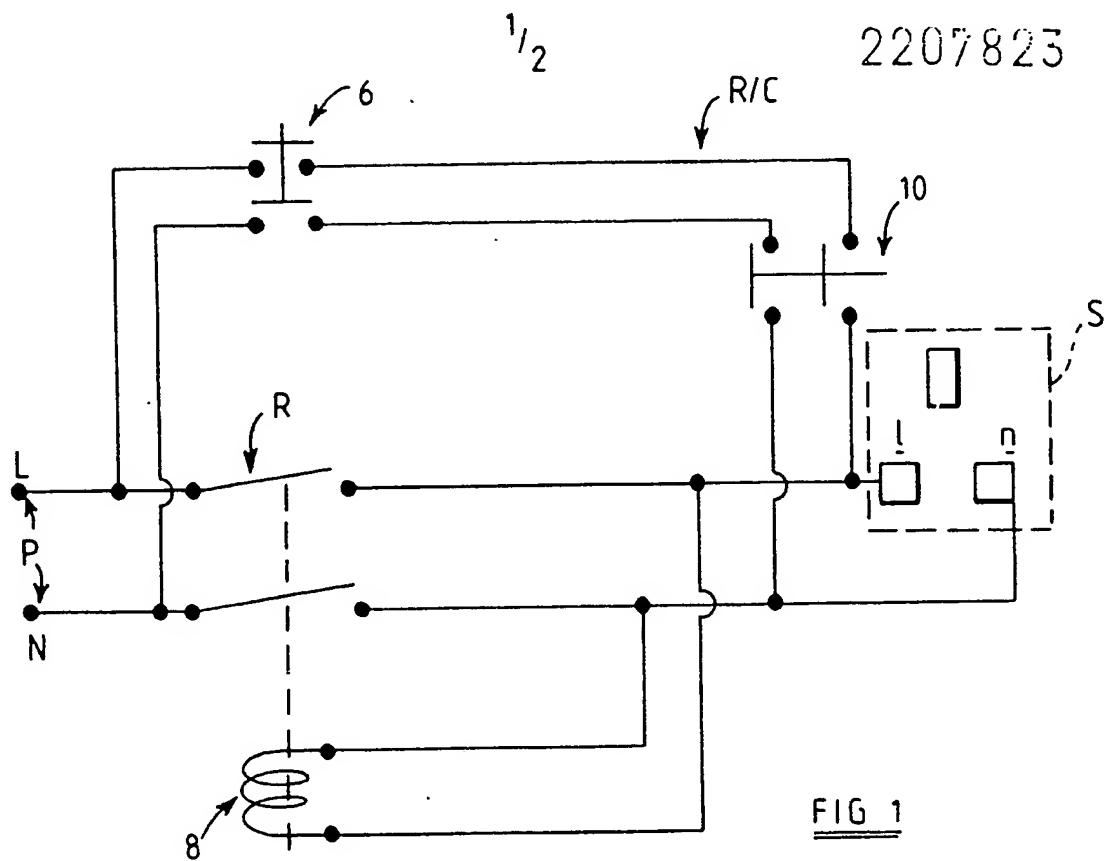
A reset circuit R/C includes a normally-open switch (6) and a power solenoid linked to the power relay R.

Located in the reset circuit R/C is a second switch (10) associated with the socket S in a manner such that, when a plug is inserted into the socket the switch is opened, and when the plug is withdrawn from the socket, the switch closes. In this manner the reset circuit R/C cannot be energised whilst a plug is in the socket.

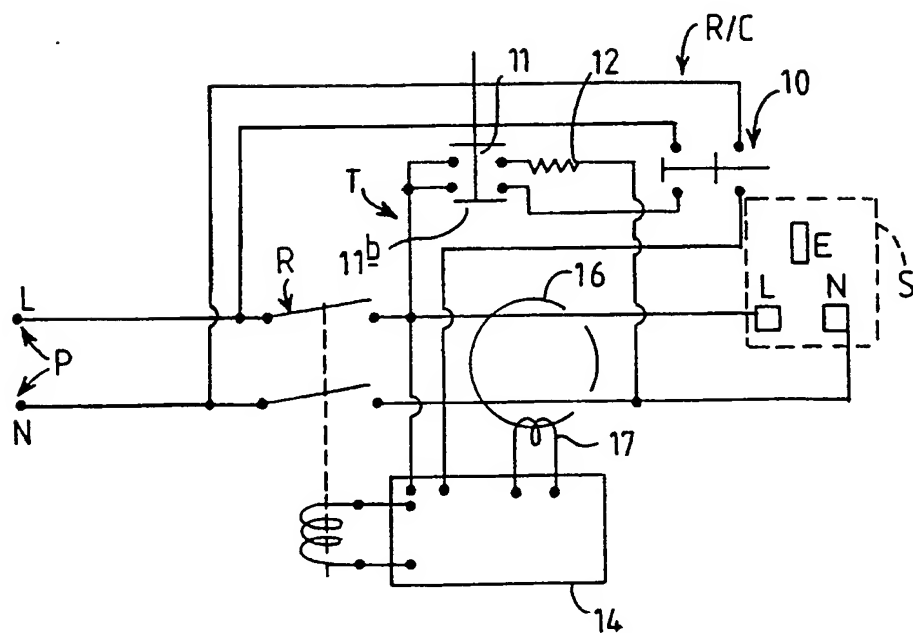
A test circuit T includes a further switch (11) interlocked with switch (6) to prevent simultaneous operation.

**FIG 2**

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 $2\frac{1}{2}$ FIG 3

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"Improvements relating to circuit breakers"

Description of Invention

This invention is concerned with improvements relating to circuit breakers, in particular to a circuit breaker of the kind (hereinafter referred to as being of the kind specified) comprising a socket for the reception of the pins of an electric plug, a power supply line extending to the socket, and a relay in the power line (hereinafter referred to as being "power relay") which moves on the detection of an overload current, and/or the existence of residual current, to an open condition.

Conventionally such a circuit breaker includes a reset means by which the power relay may be reclosed, such as through the intermediary of a solenoid.

Carrying out the reset operation when the circuit is under load (whether or not an overload situation is present) has the disadvantage that sparking may occur and cause welding of the power relay contacts, which can cause the relay, and hence the safety of the circuit breaker, to become ineffective.

According to this invention there is provided a circuit breaker of the kind specified comprising a second relay in a reset supply line, the second relay being open when a plug is in the socket and closed in the absence of a plug in the socket.

The second relay may be afforded by means which is operative to detect the presence or absence of a plug in the socket, and which is operative to control the state of the reset supply line. For example such means may comprise a switch in the reset supply line which is depressed on the insertion of a plug into the socket, and which upon such depression moves to an open condition to prevent energisation of the reset supply line.

The circuit breaker may comprise a separate reset button, depression of which if no plug is in the socket, will be effective to close the reset relay which will be effective to close the power relay, conveniently by the energisation of a power relay solenoid, and provide a potential to the pin apertures of the relay. However if a plug is present in the socket, the reset

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supply line will be open and depression of the reset button will not be effective to close the power relay.

In this manner resetting of the power relay with a plug in the socket, and the possibility of closing the power relay under load (including overload) conditions is prevented.

Alternatively however where the plug-detection means is in the form of a switch which is opened when a plug is inserted into the socket, and which closes when the plug is withdrawn, a separate reset button may be omitted, the plug-activated switch in effect providing the resetting means, with withdrawal of the plug allowing the switch to close to effect a resetting operation, and insertion of the plug opening the switch and hence opening the resetting circuit.

The invention may be utilised in a circuit breaker also comprising a "test" button which may be depressed to test the state of the circuit, although in such circumstances desirably an additional reset switch is included which is linked to the test button to prevent simultaneous operation of the test and reset buttons.

Conveniently the test circuit comprises a test relay operative in a manner such that, with the power relay open, closing of the test relay causes current to flow through the power circuit, conveniently through a protected resistor. Advantageously a toroid is provided which extends around the live and neutral lines of the power circuit, an output from a secondary core of which being applied to a control device operative to check the circuit.

There will now be given a detailed description, to be read with reference to the accompanying drawings, of two embodiments of this invention which have been selected for the purpose of illustrating the invention by way of example.

In the accompanying drawings:

FIGURE 1 is a circuit diagram of a circuit breaker which is the first embodiment of this invention;

FIGURE 2 is a circuit diagram of the circuit breaker which is the second embodiment of this invention; and

FIGURE 3 is a circuit diagram of a modification of the second embodiment.

The circuit breaker which is the first embodiment of this invention comprises a power supply line P extending from terminals N and L to pin

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apertures N, L of a plug-receiving socket S. Positioned in the power supply line (across each of the live and neutral lines) is a power relay R which is opened by means (not shown) on the occurrence of a current overload or the detection of residual current.

The circuit breaker also comprises a reset circuit R/C which includes a normally open switch 6 and a power solenoid 8 linked to the power relay. On the application of power to the reset circuit R/C and consequent energisation of the solenoid 8, the power relay R is closed.

Located in the reset circuit R/C is a second switch or relay 10, which is associated with the plug-receiving socket S in such a manner that, when a plug is inserted into the socket the switch 10 is opened, and when the plug is withdrawn from the socket, the switch 10 closes. In this manner the reset circuit R/C cannot be energised whilst a plug is in the socket S: with no plug in the socket the reset switch may be closed to energise the solenoid 8, which closes the relay R.

If desired the switch 6 may be omitted, allowing a resetting operation to be effected solely by a withdrawal of the plug from the socket S, the switch 10 opening when the plug is inserted into the socket S.

In the embodiment illustrated in Figure 2, in which like numerals have been used to indicate like parts, a test circuit T is included, which comprises a relay 11 which when closed causes current to flow through the power circuit through a protected resistor 12. A toroid 16 is passed around the live and neutral supply lines, and powers a secondary coil 17 which provides an input to a control device in the form of a printed circuit board 14. In this manner the state of the circuit may be checked, although desirably in such circumstances a reset switch 6 in addition to the switch 10 is included, and which is interlocked with the switch 11 in a manner which prevents simultaneous operation.

Thus with an appliance connected to the circuit, a plug in the socket S and the switch 10 in consequence open, the circuit may be tested to enable the user to confirm that an out of balance current through the toroid will trip the device, to cause opening of the power relay R. Thereafter resetting of the relay cannot be carried out until the plug is removed from the socket, and the switch then closed.

If no appliance is connected to the socket, and the switch 10 is closed, the test button 11 may be depressed to test the circuit, provided that the reset circuit R/C is open.

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Thus the presence of the switch 6 fulfills two functions, firstly to isolate the reset circuit from the toroid, and secondly to permit the relay R to open and stay open until a positive action is taken to reset the device.

In the modification illustrated in Figure 3, the control device 14 is connected to the "supply" side of the toroid, and a second, normally closed switch 11b is provided in parallel with the test switch 11. Thus when the test button is depressed, closing the switch 11, the switch 11b opens so then even when relay R opens there is no alternative supply path to the control device 14 when the socket switch 10 is closed.

With this arrangement, tripping of the device an appliance connected to the socket is unaffected and resetting is effected simply by the removing and reinsertion of a plug into the socket S.

If in the arrangement shown in Figure 3 the circuit is tested with an appliance connected, the relay will trip and remain open as long as the test button is depressed: on releasing the test button, closure of the contact 11b re-establishes a supply of power to the control device and the relay will reset.

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, or a class or group of substances or compositions, as appropriate, may, separately or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

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CLAIMS:

1. A circuit breaker of the kind specified comprising a second relay in a reset supply line, the second relay being open when a plug is in the socket and closed in the absence of a plug in the socket.
2. A circuit breaker according to Claim 1 comprising means which is operative to detect the presence or absence of a plug in the socket, and which is operative to control the state of the reset supply line.
3. A circuit breaker according to Claim 1 comprising a switch which is depressed on the insertion of a plug into the socket, and which upon such depression moves to an open condition.
4. A circuit breaker according to any one of the preceding claims comprising a separate reset switch depression of which if no plug is in the socket will be effective to close the reset relay.
5. A circuit breaker according to Claim 4 wherein closure of the reset relay is effected by energisation of a solenoid.
6. A circuit breaker according to one of Claims 4 and 5 comprising a test relay which may be actuated to test the circuit breaker.
7. A circuit breaker according to Claim 6 wherein the test relay is operative in a manner such that, with the power relay open, closing of the test relay causes current to flow through the power circuit.
8. A circuit breaker according to Claim 7 wherein the current flows through the power circuit through a protected resistor.
9. A circuit breaker according to one of Claim 7 and 8 comprising a toroid extending around the power circuit, an output from the secondary coil of which being applied to a control device operative to check the circuit.

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10. A circuit breaker according to any one of Claims 6 to 9 wherein the separate reset switch is interlocked with the test relay in a manner which prevents simultaneously closing.

11. A circuit breaker according to Claim 10 wherein the reset switch is connected to the test switch in a manner whereby both switches are operated by a single control member wherein when the test switch is closed the reset switch is opened, and when the test switch is opened the reset switch is closed.

12. A circuit breaker constructed and arranged substantially as hereinbefore described with reference

- (a) to Figure 1;
- (b) to Figure 2; or
- (c) to Figure 3 of the accompanying drawings.

13. Any novel feature or novel combination of features as hereinbefore described and/or as shown in the accompanying drawings.